NON-PUBLIC?: N
ACCESSION #: 9304260266
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Limerick Generating Station, Unit 2 PAGE: 1 OF 6

DOCKET NUMBER: 05000353

TITLE: Reactor SCRAM and PCRVICS actuation resulting from a closure of the Main Turbine Stop Valves due to air entrained in the Main Turbine Electro Hydraulic Control system.
EVENT DATE: 03/26/93 LER #: 93-005-00 REPORT DATE: 04/22/93

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On March 26, 1993, during performance of a Surveillance Test procedure, a Unit 2 reactor SCRAM occurred in response to an inadvertent closure of the Main Turbine Main Stop Valves (MSVs). The reactor SCRAM was followed by a Main Turbine trip. Reactor water level decreased to +12.5 inches as expected, and various Primary Containment and Reactor Vessel Isolation Control System (PCRVICS) actuations occurred, however, no PCRVICS valve movements occurred. The Reactor Core Isolation Cooling system and the High Pressure Coolant Injection system received spurious initiation signals, but neither system injected into the reactor vessel. The reactor shutdown automatically and all control rods fully inserted as designed. Operations personnel successfully controlled the plant shutdown using the appropriate plant procedures. Unit 2 was returned to

power operation on March 28, 1993. An investigation included that the MSV closures resulted from air entrapment in the Main Turbine Emergency Trip System (ETS) which is supplied by the Electro Hydraulic Control (EHC) system. The primary cause of the air entrapment was a procedure deficiency which did not adequately identify when to vent air from the ETS/EHC systems. A contributing factor to the cause was that orifices required to mitigate the effects of air in the ETS/EHC systems had not been installed. As a result of this event, a procedure revision was made, the required orifices were installed, and additional evaluations of this event are planned.

END OF ABSTRACT

Unit Conditions Prior to the Event:

Unit 2 Reactor was in Operational Condition (OPCON) 1 (Power Operation) operating at 100% power level. Operations personnel were performing Surveillance Test (ST) procedure ST-6-001-760-2, "Main Turbine Stop and CIV Valve Exercise."

There were no structures, systems, or components out of service that contributed to this event.

Description of the Event:

On March 26, 1993, at 1342 hours, while Operations personnel were performing procedure ST-6-001-760-2, a reactor SCRAM occurred as a result of a Reactor Protection System (RPS) (EIIS:JD) actuation due to the inadvertent closure of the Main Turbine Main Stop Valves (MSV) (EIIS:PCV). The SCRAM was followed by a Main Turbine trip (EIIS:TRB) resulting from the closure of the MSVs and the Intermediate Stop Valves (ISV). A preliminary event investigation concluded that the Main Turbine MSV and ISV closures occurred as a result of air entrapment in the hydraulic fluid supplied to the Main Turbine Emergency Trip System (ETS). The hydraulic fluid is supplied by the Electro Hydraulic Control (EHC) system and is used to control the positioning of the Main Turbine valves and to actuate a turbine trip.

Following the reactor SCRAM, reactor water level decreased from a normal level of +35 inches to +12.5 inches (i.e., the zero reference point being 161 inches above the top of the active fuel) as expected. Actuations of the Primary Containment and Reactor Vessel Isolation Control System (PCRVICS) (EIIS:JM), an Engineered Safety Feature (ESF), occurred as a

result of the vessel low water level signal. The PCRVICS actuations resulted in an isolation signal being sent to the following previously isolated Unit 2 systems:

o the Residual Heat Removal (RHR) (EIIS:BO) Shutdown Cooling System, and

o the RHR Heat Exchanger Sample and Drain Lines, and no valve motion occurred in either system.

The High Pressure Coolant Injection (HPCI) (EIIS:BJ) system, and the Reactor Core Isolation Cooling (RCIC) (EIIS:BN) system received spurious initiation signals due to momentary spiking (i.e., noise) of reactor vessel level instrumentation to below the initiation setpoint of -38 inches instrument level (i.e., reactor vessel low-low water level setpoint). The spurious water level signal was the direct result of the closure of the Main Turbine MSVs from full power. Although both the HPCI and RCIC systems received initiation signals, the spurious signal did not exist long enough to cause either system to fully initiate and to automatically inject into the reactor vessel. After the HPCI system received the spurious initiation signal, the system started in the min

flow mode, oversped, and automatically reset several times before Operations personnel placed the HPCI system in the full flow test mode.

The Transient Response Implementation Plan (TRIP) procedures T-101, "RPV Control," and T-99, "Post SCRAM Restoration," were executed by Main Control Room (MCR) personnel following the reactor SCRAM. The reactor shutdown was accomplished with no abnormalities. All control rods fully inserted following the reactor shutdown. Reactor coolant level was restored to normal level using the feedwater system. General Plant (GP) procedure GP-3, "Normal Plant Shutdown," was executed to continue with normal shutdown activities. Procedure GP-8, "Primary and Secondary Containment Isolation Verification and Reset," was executed to reset the PCRVICS isolation signal. Following recovery from the SCRAM and a review of the event, Unit 2 entered OPCON 1 on March 28, 1993, at 0407 hours.

A four hour notification was made to the NRC at 1658 hours, on March 26, 1993, in accordance with the requirements of 10CFR50.72(b)(2)(ii), since this event resulted in automatic actuations of the RPS and ESF. This LER is being submitted in accordance with the requirements of 10CFR50.73(a)(2)(iv).

Analysis of the Event:

The reactor shutdown occurred automatically and all control rods fully inserted as designed. Although the Main Turbine MSVs and ISVs were affected by the ETS perturbation, the Main Turbine control valves and bypass valves were unaffected and functioned as designed. MCR Operations personnel successfully controlled the plant shutdown using the appropriate Plant procedures. No reactor vessel Main Steam Relief Valves lifted, and no Emergency Core Cooling Systems injected into the reactor vessel as a result of the event. The actuations of the PCRVICS functioned as designed in response to the reactor vessel low water level signal. There was no release of radioactive materials to the environment as a result of this event.

A Main Turbine trip from high power is the most severe transient that the plant is anticipated to undergo, from an instrument response viewpoint. The reactor vessel water level oscillations and the resulting instrumentation spiking experienced during this Main Turbine trip were consistent with the results of previous tests on both Units 1 and 2. The spurious initiation signals received by the HPCI and RCIC systems were a result of the reactor vessel water level instrumentation spikes. Both the HPCI and RCIC systems remained operable throughout the event. If a valid initiation signal had occurred at any time during this event, the initiation signal would have existed long enough for either system to perform its intended safety function. The HPCI system's response to the spurious reactor vessel level transient is currently being evaluated.

Cause of the Event:

The reactor SCRAM was the result of an inadvertent closure of the Unit 2 Main Turbine MSVs while the unit was operating at 100% power. Just prior to the reactor SCRAM, the Main Turbine ISV No. 6 was stroked closed by Operations personnel as part of the performance of procedure ST-6-001-760-2. Approximately twenty seconds after the ISV No. 6 was closed, the MSVs closed, initiating the RPS trip/SCRAM actuation. The SCRAM was followed by a Main Turbine trip in response to the MSV closures and the additional closure of all Main Turbine ISVs.

An investigation concluded that the Main Turbine valve closures occurred as a result of air entrapment in the Main Turbine ETS at the Control Pac for the ISV No. 6. The EHC system provides the operating fluid for the Main Turbine ETS. The Control Pac is associated with the valve actuator for ISV No. 6, and controls the opening and closing of ISV No. 6 based on signals from the electronic subsystem of the EHC system. The air entrapment led to a perturbation in the ETS fluid which controls the disk

dump valves on the Control Pacs of, the MSVs and ISVs. Evaluations addressing the cause and the contributing factor of this event are provided below.

1. Cause of the ETS system perturbation.

Following a Unit 2 Main Turbine trip or extended periods that the EHC system is out of service, air may migrate into the fluid system. The 'original' design of the Main Turbine valve Control Pacs allowed entrapped air to migrate through the system and to be vented out during operation of the EHC system, without perturbations occurring. During the recent second Unit 2 refueling outage, isolation valves that are part of the Control Pacs of four ISVs (i.e., ISVs 1,3,4, & 6) were found to be defective and were replaced. The isolation valves were replaced with the new design isolation valve type recommended by the Main Turbine manufacturer (i.e., General Electric (GE) Company) in their Turbine Information Letter (TIL) GE TIL 894, "Servo Valve Isolation Package."

Industry experience following the issuance of GE TIL 894 has shown that the recommended replacement isolation valve type for the Control Pac tends to trap air which migrates into the EHC system. These new replacement isolation valves are currently installed only on the Unit 2 EHC system. The Unit 1 EHC system has the original design Control Pac isolation valves, and therefore, air entrapment on this system does not occur. In order to ensure that the air is removed from the EHC system during a Main Turbine startup, a Unit 2 specific Routine Test (RT) procedure RT-6-031-206-2, "Main Turbine Valve Stroking To Vent EHC Oil Lines," is utilized. This procedure is consistent with guidance provided in the applicable GE document GEK 63346, "EHC Control Pac - Servo Valve Isolation Scheme."

During the Main Turbine startup on March 16, 1993, from the recent Unit 2 refueling outage, the RT procedure was performed to vent the EHC hydraulic oil lines. Stroking of the Main Turbine valves in accordance with the RT procedure indicated no EHC system perturbations, and the Main Turbine was successfully started. On March 17, 1993, a Main Turbine trip occurred due to a loss of generator stator cooling water. Following the subsequent Main Turbine trip we have concluded that air migrated into the EHC system, and became entrained in the ETS at the Control Pac for the ISV No. 6. Due to a procedural deficiency in the General Plant (GP) procedure GP-2, Appendix 3, "Startup of the Main Turbine," the venting RT procedure was not performed during this subsequent Main

Turbine startup, which occurred on March 17, 1993. Procedure GP-2 did not identify the requirements to perform the venting RT procedure.

As a result, the air remained trapped inside the Control Pac for the ISV No. 6 following the Main Turbine startup on March 17, 1993. The Main Turbine continued to operate satisfactorily following March 17, 1993, however, during the performance of procedure ST-6-001-760-2 on March 26, 1993, the ETS, system pressure collapsed with the stroking of ISV No. 6. This pressure perturbation was severe enough to actuate the disk dump valves on the MSVs and the ISVs, and cause the reactor SCRAM and the subsequent Main Turbine trip.

2. Contributing factor to the event:

As part of the investigation following this event, it was determined that the installation of orifices in the Fast Acting Solenoid ports in the Control Pacs with the replaced isolation valves (i.e., ISVs 1,3,4,& 6) can mitigate the effects of air entrapment. These orifices were found to be not installed in the Fast Acting Solenoid ports for those ISVs that had the isolation valves replaced during the second Unit 2 refueling outage. The reason why these orifices were not installed is currently under investigation.

Corrective Actions:

1. A revision to procedure GP-2, Appendix 3 was made on March 27, 1993, to require the performance of the Unit 2 specific procedure RT-6-031-206-2
ollowing work on the EHC system or following a Main Turbine trip. Performance of the RT procedure on the Unit 1 EHC system is presently not required. The Unit 1 system has the 'original' design Control Pac isolation valves which allows the air to be vented out during operation of the EHC system where air entrapment does not occur.

2. The orifices were installed in the Fast Acting Solenoid ports on the ISV Nos. 1,3,4, and 6 on March 27, 1993, during the unscheduled Unit 2 shutdown. In accordance with the RT procedure, the Main Turbine valves were cycled open and closed during the Main Turbine startup, and no EHC/ETS system

perturbations were identified. A review of the other Unit 2 EHC system Control Pacs with the replaced isolation valves was

performed, and the required orifices were verified to be installed.

3. Further analysis of this event will be performed to address any additional corrective actions to preclude the recurrence of this event. This analysis is expected to be completed by April 30, 1993.

In addition to the corrective actions stated above, the following actions will be completed.

o An evaluation will be performed to address whether the inadvertent HPCI and RCIC system initiations, due to reactor level instrumentation spiking following a Main Turbine trip, can be minimized. Any actions as a result of this evaluation will be implemented as necessary.

o An evaluation of the HPCI system response during the spurious reactor vessel level transient was performed. Although the HPCI system was operable throughout this event actions are being evaluated to improve the HPCI system's response on min flow to reduce unnecessary challenges to the HPCI system.

Previous Similar Occurrences:

No previous SCRAMs or Main Turbine trips have occurred on either Unit due to the cause of this event.

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